pplement to June, 1944—No. 8

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TRANSACTIONS

OF THE

NEW YORK ACADEMY OF SCIENCES

SERIES II

VOLUME 6

NEW YORK
PUBLISHED BY THE ACADEMY
1943-1944

Assistant Editor
ETHEL J. TIMONIER

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TRANSACTIONS
of
THE NEW YORK ACADEMY OF SCIENCES

Ser. II, Vol. 6 NOVEMBER, 1943 No. 1

SECTION OF BIOLOGY[1]

OCTOBER 11, 1943

DOCTOR HERBERT ELFTMAN, Department of Anatomy, College of Physicians and Surgeons, Columbia University, New York, N. Y.: *Experimental Studies on the Dynamics of Human Walking.* (This lecture was illustrated by lantern slides and motion pictures.)

Walking is one of the more intricate human activities. The superficial ease with which it is accomplished is due to the success with which Nature, after persistent trial and error, has brought together dozens of bones and hundreds of muscles under the co-ordinating control of a nervous system which can make even the complicated seem simple.

The problems connected with human movement are numerous, ranging from the evolution of the skeletal framework to the measurement of energy expenditure. A proper solution of these problems depends upon accurate knowledge of the fundamental mechanism of movement. This could not be obtained until quantitative experimental methods were applied.

One of the paradoxes of walking is the fact that if a person walks a mile on the level, at a constant average velocity, he has done no work on the body in a physical sense, since he finishes with the same potential

[1] The Section of Geology and Mineralogy met October 4, 1943. Doctor Parker D. Trask gave an address entitled, "The New Mexican Volcano Parícutin, and its Geologic Setting," illustrated by Kodachrome slides. An abstract will be published in the December number of the Transactions.

TRANSACTIONS of The New York Academy of Sciences, Series II, Volume 6, No. 1, November, 1943.
This publication is distributed to Members and is published monthly from November to June, inclusive, at 109 West Chestnut Street, Lancaster, Pa., by The New York Academy of Sciences, Seventy-ninth Street and Central Park West, New York City.
Executive Secretary: Eunice Thomas Miner.
Assistant Editor: Ethel J. Timonier.
Entered as second-class matter December 2, 1938, at the post office at Lancaster, Pa., under the act of August 24, 1912.

and kinetic energy as he had when he started. But there is no doubt that his muscles have been working. An accurate measurement of the amount of energy used can be obtained by measuring metabolism by standard methods. A person weighing 110 pounds would use from 40 to 80 large calories in transporting himself over the one-mile distance, the actual amount depending on just how he walked. If he walked in the most economical fashion, it would take him half an hour to accomplish the mile, and the energy used up would be capable of keeping an 80 watt bulb shining all the time he was walking. If, instead, he could seat himself in a frictionless wheel-chair and apply this energy to pushing the chair, it would be sufficient to push him up an incline so steep that he would gain over 1000 feet in altitude for each horizontal mile.

Why must the body use so much energy to accomplish the simplest type of locomotion? The answer may be obtained by physical analysis of the mechanism by means of which the body moves. The body consists of a number of parts, each one of which may be considered to move as an essentially rigid unit. By means of instrumental recording and photography, the movements and the forces associated with them may be analyzed.

When this is done, it is found that the velocity of the body is by no means constant during walking. Each time a foot is placed upon the ground, the velocity decreases, to rise again as the foot prepares to leave. The kinetic energy of each leg is greatest during the forward swing. It must then decrease as the foot is about to be planted.

These changes in kinetic energy must be brought about either by the action of gravity or by the action of muscles, since friction and wind resistance are small at the speed of walking. The work done by muscles can be separated from that done by gravity only by detailed kinematic analysis, although limiting values may be obtained by calculating kinetic and potential energies.

The upward and downward movements of the trunk have been accused of being the cause of the muscular work done during walking. That this is not the case with steps of moderate length is proved by the fact that the upward and downward movements of the trunk are of such a nature that gravity is responsible for the greater part of the fluctuation in kinetic energy of the upper part of the body. As the trunk rises in the middle of the step, its velocity decreases, the process being essentially one of the trunk vaulting forward, using the leg as a pole. The decreasing kinetic energy of the trunk is converted into potential energy.

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The movement of the legs is a different matter. It is in accomplishing the leg movements that most of the muscular work is done. At ordinary speeds of walking, the forward swing of the leg must be initiated by the shortening of appropriate muscles. At the termination of the swing, the opposite set of muscles must go into action. By stretching these muscles, the leg slows down sufficiently to allow the foot to be planted on the ground.

The regulating factors for the pattern of movement and the energy levels of the body are consequently the muscles. They are suited to this purpose by their fundamental properties. When a muscle is activated by a nerve impulse, it becomes tense, pulling at both of its attachments. This process, in itself, uses up chemical energy. By shortening, the muscle can then do work on the body, as in increasing kinetic energy. If the active muscle is stretched, it takes energy away from the physical mechanism. When the active muscle neither shortens nor lengthens, it stabilizes the joint over which it acts.

When we walk on the level with an even rhythm, the muscles regulate the physical energy of the body in such a fashion that the amount of energy they take out of the walking mechanism during certain portions of the step is exactly equal to the amount of energy which they put in during the other portions. If the muscles were only able to save the energy which they take out and then give this energy back a moment later, walking would require much less effort. This seemingly simple arrangement is, however, one of which muscle is incapable. The energy which the muscle takes out is not only wasted as heat, but the muscle actually burns up chemical energy in the process. It is conceivable that artificial limbs could be designed in which this storage of energy could actually be accomplished.

More practical methods are available for decreasing the muscular energy used in locomotion. By choosing a moderate length of step and walking at the rate of about one and a half steps per second, the energy used is a minimum. Under these conditions, the leg swings with approximately the period it would have when suspended as a pendulum and consequently the greatest possible use is made of gravity.

Another method of reducing energy expenditure is to correlate the swinging of the two legs in such a fashion that one leg is gaining energy at the same rate as the other leg is losing it. This cannot be accomplished in walking but is approached in running. It is responsible for the

fact that running is more economical than we would otherwise expect it to be.

Other factors, such as the change in efficiency of muscular contraction with the rate of contraction, and the utilization of the long muscles which span more than one joint, are significant in a more detailed consideration of the problem of locomotor energy expenditure. Even these factors are dependent on the mechanical structure of the body in their application. Properly co-ordinated management of the movements of the parts of the body furnishes a fundamental key to efficiency of movement.

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SECTION OF PSYCHOLOGY

October 18, 1943

Doctor Andras Angyal, Resident Director of Research, Worcester State Hospital, Worcester, Massachusetts: *Basic Sources of Human Motivation.*[1]

The holistic point of view in the study of human nature is now rather widely accepted. At present it is hardly necessary to enumerate the arguments for the need of studying the human being as an integrated whole rather than an aggregation of artificially created segmental functions. The timely task is not to justify the legitimacy and necessity of the holistic approach but to exploit fruitfully its implications in further theoretical formulations and in the actual investigation of the various phases of human activity.

Tonight, I wish to present some holistically oriented theoretical formulations with regard to the basic sources of human motivation.

Once the statement is made that "the person is a whole," a *gestalt*, or whatever term one may use to express the idea of an integrated totality, the need for further specification and elaboration arises. One wants to know what the specific features of this totality are that distinguish it from other totalities. One wants to know what the specific characteristics and laws are that apply to it.

The first specification one can make is that the person, or any living being, is a *dynamic whole.* There are objects more or less static in nature, such as geometrical forms, crystals, etc., that can be studied adequately as morphological configurations. Another class of phenomena can be adequately studied only dynamically. The living organism belongs to this latter class. This idea has been aptly expressed by Jennings in his statement that "the organism is a process." Even the structural features of the organism, such as the morphological pattern of the heart, or the lungs, have their full meaning and significance only in relationship to the function that they are carrying out within the total organismic process. Since the word organism frequently has by convention a morphological connotation, it may be said that the study of living beings in general, and of the person specifically, should be a study of the organismic total process; in other words, a *study of the processes of living.* The cur-

[1] See also, **Angyal, Andras.** "The Foundations for the Science of Personality." The Commonwealth Fund. New York. 1941.

rent use of the concept of life is derived mainly from physiology. In the present context, however, I will use this concept in a much broader sense and refer by it to a physiologically, symbolically (i.e. psychologically) and socially integrated total process.

The next step in specifying the general holistic concept of man will consist in an attempt to detect the broad, over-all pattern of the organismic total process. Our problem is, then, to describe the general pattern according to which life process takes place.

Current definitions of living derive mainly from physiology and organic biology. So great has been the influence of the static point of view that, even in the definition of a process like living, certain rather static features have crept in. Most, if not all, definitions of life imply a notion of a kind of pendular oscillation about a point of equilibrium instead of a progression in some definite direction. One speaks of disturbances of equilibrium and re-establishment of equilibrium as a basic characteristic of living; that is, a limited range of oscillation around a static point. This type of hypothetical model has been formulated in various ways. Sometimes life is defined as a periodic oscillation between anabolic and catabolic processes, a periodic cumulation and dispersion of matter and energy. The definition of life as a process of self-preservation is also an essentially static conception of living, implying as its goal the maintenance of a *status quo* and disregards the progressive, forward surging trend which, to my mind, is the most characteristic feature of living. The concept of homeostasis, which is a useful concept, if applied to certain highly standardized part patterns of the total process of living, is fundamentally extremely static and, hence, inadequate for the description of the total pattern of the life process.

The formulation that I am going to develop conceives the over-all pattern of living as a dynamic trend of progression in a definite direction and not as an oscillatory motion about a point of equilibrium.

In order to develop this idea, we have to examine briefly another concept; namely, that of the *autonomy* of the organism. By autonomy is meant that the human being, or any other organism, does not behave passively, does not act entirely under the compulsion of the impacts of environmental influences, but is endowed with a certain degree of self-government. The organism is not an inactive point in which various environmental causal chains intersect—as mechanistic theories want us to believe—but, to a certain degree, is the cause and active originator of its functions. We may say with Adolf Meyer that the organism is en-

dowed with spontaneity. Or we may say that the organism possesses a certain degree of freedom, if we use this concept in the sense of Spinoza and call "free" an entity which acts according to its intrinsic law and not under the compulsion of exogenous forces.

This autonomy, this internal steering or self-government, is implied in all characteristic life-activities, such as selection, choice, regeneration, adaptation, self-regulation, etc. Only in an organism that is capable of self-directed activity are such functions possible. Even the phenomenon of tropism—which often has been used as a choice example for the demonstration of an assumed mechanical character of the life-processes—definitely involves autonomy of the organism. For instance, in the case of geotropism the plant has not a single but a variety of responses to the stimulus of gravitation. It may resemble a mechanical happening when the plant, in response to gravitation, sends its roots downward. However, in response to the same stimulus of gravitation the plant sends its stems upward and its branches sideward. It is easily demonstrated that the stimulus response process in general—though it has been frequently mechanistically interpreted—definitely implies autonomy, spontaneity of the organism. In psychology, a point of view is gaining increasing acceptance according to which the external stimulus is not a mechanical cause of the reaction of the organism but something that *prompts* the organism to respond *in its own specific way*.

The autonomy of the organism is restricted by outside influences that, with respect to the organism, are *heteronomous*. That is, the organism lives in an environment in which processes go on independently and without regard to the organism. Every organismic part process, and the life process as a whole, is the result of two components:—the organismic autonomy and environmental heteronomy. This relationship can be expressed by the ratio $a : h$. The values of a and h respectively vary greatly from occasion to occasion. In some of its manifestations, the organism is more self-governed, in others, more steered by environmental influences, but the value of a and h in this ratio never reaches zero.

Living beings belonging to different species vary greatly according to the weight that autonomous and heteronomous influences respectively play in their life. Thus, for instance, a plant is greatly dependent for its nutrition on the composition of the soil, while animals are able to search actively for proper food. The reproductive functions illustrate such differences particularly well. In plants, even the process of fecundation is largely heteronomous: it depends on such external factors as wind and

insects. Animals, on the other hand, can actively seek a mate. These differences are not mentioned here in order to show that one form is more efficient than the other. The important fact for us is that in the life process of one species the external determination plays a greater and the internal determination a smaller role than in the corresponding life process of another species.

If one considers any individual life process as a whole, one discovers a definite trend in it toward an increase of the relative value of *a* in the *a* : *h* ratio; that is to say, *a trend toward increased autonomy*. In other words, the organism—the human person being no exception—tends to proceed from a state of lesser toward a state of greater autonomy. With the exception of one important field which will be discussed later, all activities of the person seem to fall into this pattern, so that the trend toward increased autonomy appears as the most general, over-all pattern of the total process of living. The general dynamic trend of the organism seems to be directed toward the extension of its autonomous determination over an ever increasing field of events. This is a tendency to fit the biologically chaotic items of the environment into the pattern of living. It implies mastery and domination of the environment. The operation of some such fundamental tendency, as outlined above, could not escape the attention of students of human nature and it has found its way into practically all systems dealing with personality organization. In the psychoanalytic system, the concept of aggression (in the Adlerian system, the drive for power and for superiority) is considered as a fundamental urge. Aggression, combativeness, ascendency, self-assertion, or some equivalent urge or drive, or trait, is assumed by most students of personality. Ives Hendrick, the psychoanalyst, who will be the speaker at the November session of the Psychological Section of the Academy, felt compelled by the facts to introduce into psychoanalysis the notion of an "instinct of mastery," an idea which is closely related to the concept toward increased autonomy as described here.

Our description of the general pattern of the life process implies a definite view with regard to the organism-environment relationship. It implies that life does not take place within the organism, and it does not depend on intraorganismic relationships alone, but that it takes place *between* organism and environment. Organism and environment are considered not as separate entities but as two poles of a unitary process of living.

This statement may need some clarification. It is easy to demonstrate that it is impossible to draw a line of separation in space between organism and environment. It is impossible to tell just where the environment ends and the organism begins. For instance, does food become a part of the organism after it is ingested, or only when it reaches the lymph and blood circulation, or when it appears in the tissue fluids, or only when it is absorbed by the cells? The consideration of such questions could lead to endless hair splitting but not to any satisfactory solution. The obstacle is a fundamental one: it is an impossibility to describe a process in static terms. It is impossible to describe adequately organism and environment as *objects* and separate them in space. It is possible, however, at least theoretically, to state to what degree a given life process is internally determined; that is, self-governed, and to what extent it is governed by external heteronomous influences. For a dynamic consideration, environment and organism are not *objects* but *types of determination.* Dynamically, the organism is the autonomous, centralized determination and environment is the noncentralized, heteronomous determination within the total process of living.

Life is a unitary process having an environmental and an organismic pole. The realm or sphere in which the life process takes place may be termed biosphere. If one follows a holistic and at the same time dynamic approach, one does not study organic processes *and* environmental influences *and* their interrelationship, but one studies *biospheric occurrences.* Of course, one is free to make abstractions, if one only knows that he is making them, and to describe the biosphere with the subject as a point of reference or else to describe it with the object as a point of reference. In the first instance, the life process is described in terms of biological tendencies, drives, cravings, wishes and similar conceptions. Viewing life with the object pole as a point of reference, it appears as a constellation of *opportunities* and *contraventions;* that is, a constellation of such factors that either lend themselves to be constructively built into the pattern of the life process or else factors that threaten to hinder or break up the organismic total process.

Summing up the preceding discussion, we have described a tendency of living beings to move from a state of lesser autonomy toward states of greater autonomy, a tendency to master the environment. We consider this tendency as one *basic source of motivation.* Although this tendency manifests itself in the person in specifically human ways, it is a feature that the human being has in common with all living beings. In fact, if

the description presented is correct, the tendency to move toward states of greater autonomy is the most general, over-all pattern in all forms of living.

Before discussing a second basic source of human motivation, a word about the psychological mode of functioning of the organism may be in place. The type of illustrations given thus far may give the wrong impression that in the preceding formulations only the type of phenomena that the physiologist deals with is being considered and the specifically psychological or mental functions neglected.

Our point of view on this problem can be stated very briefly. The characteristic feature of the mental or psychological functions of the person is the use of symbols. In fact, psychological activity is identical with symbolic activity. Time does not permit me to justify this statement. I may mention, however, that the equating of mental activity with symbolization is not a new idea, but has been for some time an important thesis in Adolf Meyer's psychobiology. The tremendously important role that symbolic activity plays in the total activity of the person lies in its extraordinary economizing value.

The ability to function symbolically, the ability to use substitutions, is a unique endowment that some living beings possess. The emergency of this new capacity, however, does not change the basic pattern of the organismic total activity. Through the ability for symbolization, the organism gains only a new method that opens up new ways to express and actualize its inherent basic tendency toward increased autonomy.

Thus far we have considered individual lives as if they were self-contained units. This, of course, is only an abstraction. The individual in general, and the person specifically, is not a closed and independent system. The human being is just one member of a phylogenetic chain, a member of a family, a member of a social group, a participant in a culture; in the broadest sense, a part of a cosmic order.

The integration of the person into the superindividual units of the social group, the assimilation of its culture, of its written and unwritten codes, are just as essential characteristics of personality as the more individualistic functions. The person is a larger unit than a mere individual organism because he includes those factors through which it functions, as a participant in the superindividual units of society and culture. Man, in his religious attitudes, experiences himself as a member of a meaningful cosmic order. Also, ethical and esthetic attitudes transcend the scope

of a strictly individualistic existence and a definite trend toward superindividual goals in discernible in these regions.

The attitude of the person toward superindividual units is very different from the self-assertive tendency, from the trend toward increased autonomy. While the trend toward increased autonomy aims at the domination of the surroundings, the characteristic attitude toward superindividual wholes is rather a kind of submerging or subordination of one's individuality in the service of superindividual goals. In this later trend, a person seeks union with larger units and wishes to share and participate in something that he regards as being greater than his individual self. For this principle we propose the term *"trend toward homonomy"*; that is, a trend to be in harmony with the superindividual units of a social group, nature, God, ethical world order, or whatever the person's formulation of it may be.

It is in the realm of social life in which the trend toward homonomy most commonly finds outlet. In spite of all the power-seeking, competitive and plainly utilitarian aspects of living together socially, this is still the field in which people most commonly seek outlet for their need to belong, to participate, and to share. It is an essential characteristic of the human being that he is not complete as an individual self, and he experiences loneliness and isolation when he cannot share his experiences with others. Friendship and the several varieties of interhuman relations, which somewhat vaguely are referred to as love relationships, are expressions—clearly or vaguely—of the homonomous tendency. The experiences which go under the name of empathy and the phenomena of identification belong to this class.

The attitude of sharing and participating and the feeling of belonging are not restricted to interhuman relations, but involve, to some degree, the physical environment also. Corresponding to the two basic trends, we have a peculiar two-fold attitude toward the world around us. On the one hand, this world is, to us, a constellation of opportunities to be exploited and contraventions to be overcome or to be warded off. A world which is to be conquered, a world which we want to possess. On the other hand, this is also a world in which we want to repose, to be taken into, to belong. There are some experiences that bring this attitude sharply into focus. Such may be the feeling of the man who returns home after a long time, and experiences this feeling; "These are the hills and the meadows, and the house and the town where I belong." It is not necessary, however, to go for illustration to somewhat infrequent

experiences of homonomy. In most instances, where we use the expression, "I like," whether it is to express an emotional attachment to another person, or to an object, or to a cause, a trend toward homonomy is recognizable. The specific feature of this trend is an experience of transcending one's strictly individualistic limits, a feeling of belonging to something larger than oneself.

The homonomous tendency is expressed, if not most frequently, but perhaps most clearly, in certain types of ethical, religious and aesthetic experiences, and in love relationships between people.

The range and direction of sharing and belonging may vary greatly. One person may turn toward religion, another toward some social unit; but everyone has to have some object for the expression of this homonomous tendencies. The objective existence of superindividual wholes is a problem for philosophy and the student of personality is not directly concerned with such problems. From his point of view, it is immaterial whether the person's formulations with regard to superindividual wholes are founded on reality, or are illusory. For the student of personality, the important fact is that a trend toward homonomy is easily discernible in everyone's life. Since this trend represents a powerful source of human motivation, it is a vitally important factor in personality organization irrespective of whether the superindividual wholes may be revealed by philosophical analysis to be real or fictitious.

The trend toward increased autonomy and the trend toward homonomy seem to form a dichotomy of diametrically opposed forces. In the first, one tends to master and govern the environmental happenings. One aims at achievement and conquest. In the second trend, the emphasis is displaced from the individual to the collective, to superindividual wholes, in which the person tends to participate and share.

The antagonism between these two principles is probably only an apparent one. They may be conceived as two phases of the same process:—in the trend toward increased autonomy the biologically chaotic items of the environment are fitted into the organization of the individual's life, while in the homonomous tendencies—which might be considered as a second phase—the individual seeks to fit himself into organizations larger than himself.

These two trends are regarded as representing the over-all pattern of the total life-activity of the person. It is believed that all phases of human life can be understood as specific manifestations, as part patterns of these two basic tendencies. The basic tendencies of the human being

seek expression through numerous channels that are patterned by the autonomo-physiological structure of the human body, by social conditioning and by personal experiences.

The formulations that have been presented here are admittedly highly theoretical. The main justification of presenting these formulations is that I found them a helpful background—a frame of reference—in considering problems of personality, and it may be hoped that the schema may have some degree of general usefulness and validity.

SECTION OF ANTHROPOLOGY

October 25, 1943

Doctor Frank A. Beach, Chairman and Curator, Department of Animal Behavior, The American Museum of Natural History, New York, N. Y.: *Interindividual Behavior among Animals.* (Illustrated by motion pictures of the social behavior in alligators and rats.)

Comparison of representative types of interindividual relationships in animals at distinctive levels of the phyletic series suggest the existence of certain general principles of social relationships. Reliable evidence now available is too scant to permit the precise formulation of such principles.

Studies of unicellular organisms have revealed the importance of group reactions such as mass physiology responses of certain protozoa (increase in resistance to toxins), mating preferences in clones of paramecia, relationships between population density and percentage of survival, etc. Group behavior in insects is extremely variable and the social nature of various species within the group ranges from the more or less independent existence of the solitary wasps to the highly complex societies of some ants. It is to be noted that in many types of insects maintenance of the social order is essential to the perpetuation of the species. Some forms of orientation behavior possess significant implications in the field of social relationships.

Phenomena of mass physiology have been observed in connection with the locomotor and respiratory behavior of various fishes. Schooling reactions of certain species constitute another obvious example of interindividual control. Some types of fish, such as *Betta splendens* (Siamese fighting fish), are almost constantly aggressive. Adult males rarely tolerate the presence of another member of their own sex. In other species, a rudimentary type of social order is observed. Within a community of *Xiphophorus helleri* (sword-tail), males are almost always dominant over females. Sexually dimorphic characters are especially important in this connection. If the male's sword is removed his social status is lowered to that of a female. If a sword is artificially attached to a female she rises in the dominance order. Defense of territory is shown by many species of fish, and is especially strong in connection with protection of the nesting site. One other prominent type of individual interaction at the fish level is to be seen in the co-operative beha-

vior between two members of a brooding pair. The responsibility of caring for the eggs and young is frequently shared by both parents.

Many amphibians and reptiles display aggregative behavior apparently in response to favorable environmental conditions existing in a given locality. Often such aggregations are associated with the elaboration of basic behavior patterns such as reproduction. There is some preliminary evidence to indicate that under laboratory conditions male alligators exhibit territorial defense reactions. In certain lizards (specifically *Anolis carolinensis*) mature males establish and defend geographical territories. Simulation of field conditions within the laboratory has permitted the observation that the male defends his territory against encroachment by any other male but welcomes the approach of any sexually receptive female.

Interindividual relationships among birds have been studied extensively. The most outstanding examples of this category of behavior may be gathered under the following main headings: migration, reproduction, social dominance, and territorial behavior. Little is known regarding the social relationships involved in migration reactions. It is believed that in many migrating species flock leadership changes frequently and is unrelated to dominance. Reproductive activities in some birds provide excellent illustrations of co-operation involved in nest building, brooding the eggs, feeding the young, and defending the home territory. Among those species that practice communal display and are highly gregarious, social stimulation of the breeding flock is of primary biological importance. In such instances, it has been suggested that there is a numerical threshold below which colony size cannot fall if reproduction is to occur.

The existence of social hierarchies in some birds is well known. Individuals within a flock of domestic hens tend to arrange themselves in a straight line pecking order with the result that the most dominant female may display aggression toward any other member of the flock without being attacked in return. The second ranking hen must suffer the attacks of the dominant bird but may in turn peck any other hen in the group without fear of retribution. Other individuals fall at successively lower points on the scale. Loosely associated with peck status are found various other social privileges. It has been pointed out that social status is not related exclusively to physical strength and size.

If several roosters are kept with a number of hens, the males tend to establish a social order among themselves. The least dominant rooster

is not permitted to mate with the hens and may suffer "psychological castration" with the result that he loses all inclination to mate with the females. If, in the absence of any other male, he attempts to court the hens the latter frequently will not permit him to approach. Black-crowned night heron chicks show dominance in the nest. The individual whose beak is held the highest at feeding time receives the most nourishment. In adult herons the courtship activities involve establishment of social dominance of the male. This relationship is "symbolized" when the male's beak is held higher than that of the female. Until this dominance recognition is established, successful mating cannot occur.

Many species of birds appear to establish flock territories. In other species each individual maintains and defends its own home range. The male robin is a good representative of the latter type. Among the California quail each covey, varying from 8 to 25 individuals, inhabits a given range. Although the ranges of two covies may overlap somewhat, with the result that the two groups intermingle upon certain occasions, the covies do not remain united for any length of time, but separate into their original groups after a short delay. Experimental investigation of this behavior has revealed that a bird transported from one covey to another is quickly driven off. It is of interest to note that the stranger is attacked and expelled exclusively by members of his own sex.

Many mammals, such as prairie dogs and beavers, maintain a colonial type of organization. Although the physiological and psychological factors responsible for such behavior are not clearly understood, certain survival values are obvious (warning against predators, etc.). Other groups of mammals exist chiefly in herds or packs. The simplest form of such an organization consists of a large family group as has been reported to occur in the case of the wild horse, where one stallion dominates, protects and guides a brood of mares. In such instances, supernumary adult males are usually driven off. Among other ungulates, notably sheep, the older females usually dominate the flock under most conditions. Frequently, adolescent animals are segregated according to age groups. In domestic cattle, one old female usually leads the herd and is at the same time socially dominant in other activities.

Intra-group organization in mammals varies widely with the species. Among rodents there is no clear-cut example of a hard and fast social hierarchy. Experimental work with mice has indicated the importance of generalized bellicosity or aggressiveness which leads to an impersonal

sort of group organization; but this result differs distinctly from a dominance-subordination system depending upon individual recognition (such as has been observed in domestic fowl). It is possible to create artificial societies of mice in which certain individuals are always dominant over others. Further, hereditary strains have been separated which react differentially to various social factors. For example, individuals from one strain may be completely suppressed by a single defeat, whereas members of another strain tend to become more aggressive as a result of unsuccessful combat. Investigations with mice have clearly shown the importance of previous experience of the individual in connection with the establishment and maintenance of social status.

Field observations on monkeys reveal various types of family or clan organizations. In the case of the spider monkey, adult males are usually the clan leaders. Large family groups inhabit fairly restricted home territories. In this species a rudimentary sort of co-operation is exhibited in response to real or threatened danger. The chimpanzee is recognized to be highly social in nature; and it is generally admitted that an isolated individual is not representative of the species. Individuals who have worked extensively with this primate have suggested that it inherits definite social needs or drives; and that in chimpanzee society the individual is constantly confronted with the necessity of maintaining its social status. Co-operative reactions are frequently observed. Two particularly significant aspects of interindividual relationships in the chimpanzee are to be seen in the execution of the grooming responses and in the dominance-subordination relationships between male and female. All other factors being equal, the male member of a pair is usually dominant, but during periods of sexual receptivity dominance is passed to the female. The dominance principle, as it operates in chimpanzee groups, appears to encourage initiative, responsibility and leadership; and to point to the establishment of a social system which places a premium upon social service and certain types of co-operation.

Experienced investigators working in the field of interindividual relationships have advanced the proposal that potential sociality is inherent in living organisms. This conclusion implies that "social life is not an accident appearing sporadically among a few highly evolved animals,—but rather a normal and basically widespread phenomenon" (Allee). The possible evolutionary importance of interindividual organizations is reflected in the belief of many students who suggest that a socially organized group may differ sufficiently from a non-organized

one so markedly that natural selection can operate in favor of the more or less integrated population unit.

(Factual data and theoretical interpretations embodied in the foregoing discussion have been drawn from the work of many investigators. Since this presentation was intended as a more or less nontechnical summary of the field, direct reference to specific sources has been omitted. However, major indebtedness to the publications of the following scientists is gratefully acknowledged: W. C. Allee and his collaborators at the University of Chicago, R. M. Yerkes and the staff of the Yerkes Laboratories of Primate Biology at Orange Park, Florida, the late G. K. Noble of The American Museum of Natural History.)

NEW MEMBERS

Added to the Rolls During the Summer Recess from June 17, 1943, to October 28, 1943

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Webb, Addison, B.A., Biology, Author (Research and Writings in the Natural Sciences), 1 Wall Street, New York, N. Y.

ACTIVE MEMBERS

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Ekholm, Gordon F., Ph.D., American Archaeology, Assistant Curator, Department of Anthropology, American Museum of Natural History, New York, N. Y.

Evans, Titus Carr, Ph.D., Biology and Chemistry, Assistant Professor of Radiology (Biol.), College of Physicians and Surgeons, Columbia University, New York, N. Y.

Gordon, Albert Saul, Ph.D., Physiology, Endocrinology, Instructor in Biology, Washington Square College, New York University, New York, N. Y.

Host, Per, cand. mag., Oslo University, Norway, Zoology, Lt. in Royal Norwegian Air Force, Camp Little Norway, Toronto, Canada.

Huntington, E. Irving, Entomology, Research at American Museum of Natural History; Exec. V-P. Culver, Hollyday and Company, Inc., New York, N. Y.

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